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Report No. 19097

IMPLEMENTATION COMPLETION REPORT

KOREA

ENVIRONMENTAL RESEARCH AND EDUCATION PROJECT

(Loan No. 3612-KO)

March 31, 1999

Human Development Unit
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

Currency Unit	=	Korean Won (W)
At appraisal	=	US$1 = W 785
At completion	=	US$1 = W 1223

WEIGHTS AND MEASURES

Metric System

FISCAL YEAR

January 1 - December 31

ACADEMIC YEAR

March - February

ABBREVIATIONS AND ACRONYMS

CALS	Colleges of Agriculture and Life Science
EA	Environmental Administration
EERC	Environmental Education Review Committee
EMB	Environmental Management Bureau
ERAC	Environmental Research Advisory Committee
GOK	Government of Korea
ICB	International Competitive Bidding
ICR	Implementation Completion Report
MOE	Ministry of Education
MOEN	Ministry of Environment
NICEM	National Instrumentation Center for Environmental Management
SAROK	Supply Administration, Republic of Korea (name at completion)
SNU	Seoul National University

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TABLE OF CONTENTS

IMPLEMENTATION COMPLETION REPORT

KOREA

ENVIRONMENTAL RESEARCH AND EDUCATION PROJECT

(Loan 3612-KO)

PREFACE

This is the Implementation Completion Report (ICR) for the Environmental Research and Education Project in Korea, for which Loan 3612-KO in the amount of US$60 million equivalent was approved on June 3, 1993, signed on June 30, 1993, and made effective on September 3, 1993.

The loan was closed on schedule on December 31, 1998. Final disbursement took place on March 8, 1999. The Loan was fully disbursed with no cancellations.

The ICR was prepared by Ms. Carol Hau-Lai Ball, assisted by Ms. Ruth Montague. The ICR was reviewed by Mr. Alan Ruby, Manager, EASHD, and Mr. Sri-Ram Aiyer, Country Director, EACKF. The Borrower's evaluation summary is included in an unedited form as Annex B.

Preparation of this ICR was begun during the Bank's last supervision/completion mission in October 28 to November 12, 1998, which visited the Ministry of Finance and Economy, Ministry of Education (MOE), Supply Administration, Republic of Korea (SAROK), Cheju National University, Colleges of Agriculture and Veterinary Medicine, Chungnam National University, Colleges of Agriculture and Life Science (CALS), and Veterinary Medicine, Seoul National University (SNU), and the National Instrumentation Center for Environmental Management (NICEM). The information in this report is based on materials in the Project Implementation Index File, Divisional Black Books, and submissions from the Borrower dated February 9, 1999, and March 10, 1999, as well as information received during the completion mission. The Borrower contributed to the preparation of the ICR by: (a) providing specific data upon request; and (b) contributing views reflected in its own evaluation of the project's preparation and execution. No comment (?) was provided on the draft ICR prepared by the Bank.

IMPLEMENTATION COMPLETION REPORT
KOREA
ENVIRONMENTAL RESEARCH AND EDUCATION PROJECT
(LOAN 3612-KO)

EVALUATION SUMMARY

Objectives

i. The overall objective of the project was to assist in upgrading the capacity of selected agricultural and veterinary colleges to undertake research into key environmental problems, reinforce the environmental aspects of basic science programs in the colleges in order to strengthen the training of environmental professionals and establish appropriate arrangements for improving environment-related research and teaching programs.

Implementation Experience

ii. Overall implementation was satisfactory. The Loan closed on schedule and was fully disbursed with no cancellations and no cost overruns. Disbursements conformed to all Bank procedures and included the use of Special Accounts. The allocation of the Loan among disbursement categories was similar to the original estimates (Table 8A). The small savings from the visiting expert category were spent on equipment and overseas training and caused no deviations from the original project objectives. There were no overdue audit reports at Loan Closing, and all other covenants were in full compliance.

iii. All equipment and library materials and software were purchased in accordance with Bank guidelines. Procurement of most of the specialized equipment was undertaken by the Government of Korea's (GOK) experienced central procurement agency, the Supply Administration, Republic of Korea (SAROK), using international competitive bidding (ICB) procedures.

iv. The only significant implementation problem was the unforeseen freeze on organizational changes in the GOK during the initial implementation stage which resulted in a shortage of funds for the central research facility created under the project -- the National Instrumentation Center for Environmental Management (NICEM). As a result, the Bank's supervision mission of 1994 rated the project "unsatisfactory" (Table 13). By 1996, however, NICEM had been established legally under Seoul National University (SNU) and adequate budgets were being, and continue to be, provided. No shortages of funds were experienced by the agricultural and veterinary colleges.

Results

v. All project objectives were fully met or exceeded. The project has enhanced research capabilities and teaching programs at the selected agricultural and veterinary colleges, especially concerning issues affecting the rural environment (para. 7). Research

activities and publication of findings increased steadily over the project years and the results are being used by relevant private enterprises (para. 10).

vi. NICEM was successfully established at the Suwon campus of SNU and is now in full operation (para. 8). Its laboratories are equipped with highly specialized research equipment, and relevant written and computer materials are available at SNU's central library. The Center is being used for research by the agricultural and veterinary colleges and various small and medium private enterprises. It currently has a staff of 26 plus 10 graduate student assistants (para. 21). NICEM organizes relevant workshops and symposia throughout the year.

vii. In addition, two environmental review and advisory committees were established in 1993 under the Ministry of Education (MOE) – the Environmental Education Review Committee (EERC) and the Environmental Research Advisory Committee (ERAC). They ensure the continued relevance of environmental research and teaching in Korea. Two research projects and a resulting book were completed by the committees during the project years which provide useful guidelines for development of environmental research and teaching programs (para.11).

Sustainability

viii. The GOK's continuous support for this project and for the Environmental Technology Development Project (Loan 3694-KO) indicate its clear awareness of Korea's environmental problems and the importance of maintaining a balance of attention toward its rural and urban environments.

ix. Over the years, the GOK has enacted several wide-ranging laws to help protect Korea's environment and conserve its national resources and has provided policy and planning guidance on environmental issues by upgrading the Environmental Agency (EA) to a Cabinet-level ministry. It also prosecutes environmental offenders and enforces the principle of "polluter pays" (para. 4). The GOK has thus made a long-term commitment to solving Korea's environmental problems (para. 19).

x. The research equipment financed by the project is well-maintained and managed and is highly utilized, especially at NICEM where utilization rates are very high. The national budget for 1999 provides funds for the operation and maintenance of this equipment and for the purchase of new equipment for all higher education institutions in Korea (para. 20).

xi. The institutional development under the project of NICEM, EERC and ERAC was successful and all are expected to continue their operations into the future. NICEM's annual operating budgets from the GOK continue to increase, and it raises additional funds from competitive grants, user fees and its own income generating activities. Both EERC and ERAC are expected to continue to review and advise both the NICEM and the

agricultural and veterinary colleges on their environment-related research activities and teaching programs (paras. 21 and 22).

Bank Group Performance

xii. Overall Bank performance was highly satisfactory. Efficiency and economies of scale were gained through combining the preparation of two environment-related projects with an education project (para. 24), and, as always in the education sector, by fielding a single mission to supervise all the on-going education projects in Korea at the same time (para. 25).

Borrower Performance

xiii. Overall Borrower performance was also satisfactory despite an unfavorable rating during the initial stage of project implementation caused by the unforeseen freeze on organizational changes in the GOK (para. iv). The impressive highly-satisfactory performance by the institutions, especially NICEM, during the later years of implementation made up for the time lost, and the Loan was 100% disbursed with no cost or time overruns.

Summary of Findings, Future Operations and Key Lessons Learned

xiv. Overall project development objectives were successfully achieved. Performance indicators (Table 6) were identified and monitored by the Bank during the 18 months prior to Loan Closing. Most of the targets were met or exceeded. The research capabilities of the project colleges of agriculture and veterinary sciences have been enhanced, and research activities and publication of their findings have increased steadily over the project years and are being used by related private enterprises (para. 10). A centrally located common research facility, NICEM, was established and is in full operation with adequate budgetary and financial support (paras. 9, 20 and 21). Committees for review of research activities and teaching programs related to the environment, EERC and ERAC, were established and continue to function (paras. 11 and 22).

xv. Korea graduated from borrower status in June 1995; however, due to the recent financial crisis in the East Asia region, the GOK has asked for some structural adjustment and technical assistance loans.

xvi. The lesson to be learned from this project is that frequent and detailed supervision as well as good working relationships with the Borrower can save a project and even turn around an "unsatisfactory" rating.

IMPLEMENTATION COMPLETION REPORT
KOREA
ENVIRONMENTAL RESEARCH AND EDUCATION PROJECT
(Loan 3612-KO)

PART I: PROJECT IMPLEMENTATION ASSESSMENT

A. PROJECT OBJECTIVES

1. The broad aim of the project was to strengthen Korea's capacity to address rural environmental issues, improved the teaching of its environmental programs and strengthen its environmental research. The specific objectives of the project were to assist in upgrading the capacity of selected agricultural and veterinary colleges to undertake research into key environmental problems; reinforce the environmental aspects of basic science programs in the colleges in order to strengthen the training of environmental professionals and establish appropriate arrangements for improving environment-related research and teaching programs, the latter through the establishments of the National Instrumentation Center for Environmental Management (NICEM), the Environmental Education Review Committee (EERC), and the Environmental Research Advisory Committee (ERAC). The Loan financed research and teaching equipment, library materials, and technical assistance including visiting experts and overseas training.

Sectoral Development Objectives

2. Korea's spectacular economic development over the last 30 years has had an environmental cost. Rapid urbanization and industrialization and a restructuring of the agriculture sector has resulted in rising levels of air, soil and water pollution, and a need to conserve cultivable land, forests and fisheries.

3. This project was developed along with another environment-related project financed by the Bank -- the Environmental Technology Development Project (Loan 3694-KO), which tackled urban environmental problems. This project focused on the problems of the rural environment, and therefore helped to balance Korea's environmental efforts. Rural environment problems were caused mainly by the pollution of soil and water from household and livestock waste and the increased use of agrochemicals. The GOK realized the importance of alleviating environmental degradation through: (i) the conservation of the soil and watershed of Korea's scarce cultivable land (21% of its total land area), (ii) the effective management of its extensive forests (66%) through efficient harvesting and replanting, reduction of pest damage and improved tree health, and (iii) protection of its fisheries.

Policy Issues

4. In response to the increasing complexity of environmental issues and the need to alleviate environmental degradation and manage waste disposal, the GOK over the years has created an appropriate legal and institutional framework. The first major step was taken in 1977 with the establishment of the Environmental Management Bureau (EMB) under the Ministry of Health and Social Affairs, and in 1978, the first major environmental statute in Korea -- the Environment

Preservation Law -- was enacted. This law introduced a number of important regulatory devices such as the promulgation of environmental standards, environmental monitoring and impact assessments for new projects, and emission standards and control. To strengthen implementation of the law, the EMB was upgraded in 1980 to the Environmental Administration (EA) with six regional environmental monitoring offices. In 1983, the GOK began prosecuting environmental offenders and enforcing the principle of "polluter pays". EA was further upgraded to a Cabinet-level Ministry of Environment (MOEN) in 1990 and the Basic Environmental Policy Law was enacted. This was supported by separate laws dealing with specific problems such as air and water preservation, noise control, hazardous substance control, solid waste management, and marine pollution.

5. The GOK then realized there was a need to learn more about the impact of polluting and depleting agents on the rural environment and looked to the colleges and departments of agriculture and veterinary sciences in the universities to expand their research efforts in these areas and to provide better professional training in rural environmental fields. In addition, the need to coordinate these research efforts was recognized by the GOK, and a central research organization was planned to provide common facilities for scientists from these institutions to pursue research programs and to allow a rational and efficient use of highly specialized research equipment. The GOK also established two committees to review and advise on the appropriateness of environment-related research and teaching programs at the institutions (para. 11).

Evaluation of Objectives

6. The GOK's objectives for this project were highly relevant to the rural environmental problems caused by three decades of rapid growth (paras. 2 and 3). The project has helped bring balance to Korea's environmental efforts which had had a strong urban focus. Research and teaching capabilities of rural environmental professionals have been enhanced and rural environmental problems have been properly addressed. The central research facility has been successfully established at SNU (para. 8). The results of the project's research activities and technology are being used by related private enterprises and some have received patent awards (para. 10).

B. ACHIEVEMENT OF PROJECT OBJECTIVES

7. All of the project objectives were fully met or exceeded. The project has facilitated and enhanced research capabilities and teaching programs, especially in environmental areas at 12 national agricultural colleges, 4 national universities with agriculture departments[1], and 9 national veterinary colleges. Their research outputs have been impressive (para. 10). The selected project colleges have moved their research focus increasingly away from the traditional concentration on food production and animal health toward issues affecting the rural environment such as measuring and controlling pollution, managing waste disposal, and improving the conservation of natural resources such as cultivable land, forests and fisheries.

8. One of the project institutional development targets was achieved through the establishment of NICEM, which plays an important role in facilitating collaborative research activities among scientists as well as providing them with a common well-equipped facility in a convenient central location -- the Suwon campus of SNU. NICEM is now a research organization affiliated legally with SNU's College

[1] They are Gangnung, Gongju, Mokpo and Andong Universities.

of Agriculture and Life Science (CALS). To ensure its institutional sustainability, NICEM has not only secured annual national operational budgets through SNU but has also generated funds from other financial programs (para. 21).

9. Research capability and teaching programs at the colleges of agriculture and veterinary sciences were enhanced and strengthened through the provision of highly specialized equipment, overseas training and library materials as well as through visits of foreign experts. More than 5,000 pieces of equipment were provided under the project and a total of 150 staff received training overseas. The numbers of trainees exceeded the original plan by more than 100% (Table 5), due to the efficient management by NICEM of the fellowship program. In addition to 112 professors and teachers from the colleges and 19 staff members of MOE and SNU, 19 laboratory technicians and graduate students (who are the key staff for maintaining, operating and handling the highly specialized research equipment) were also selected for training. Upon their return, all trainees were required to share their newly acquired knowledge by participating in presentations and lectures at annual symposia organized by NICEM. Relevant library materials were also purchased by NICEM and made available to researchers at the CALS/SNU central library. For example, CD-ROMs and micro-fiches of environmental sciences literatures and databases were installed in the library's computer. A total of 45 foreign experts from 11 countries also participated in the research activities and conducted seminars and workshops at the various agricultural and veterinary colleges (para. 17).

10. Research activities conducted by the agricultural and veterinary colleges and NICEM increased an average of 33% annually over the project years. A total of 8,114 research activities were conducted during this time, about 80% over appraisal estimates. The results of 97% of these activities were published either domestically or internationally, 23% were related to the environment, 15% have been used by related industries, and 2% have been awarded patents (Table 7).

11. Another project institutional development target was achieved in 1993 when the two environmental committees to review and advise on the appropriateness and relevance of the research and teaching programs at the project institutions were established -- the Environmental Education Review Committee (EERC)[2] and the Environmental Research Advisory Committee (ERAC)[3]. These committees continue to function with most of their input being made through NICEM. Both committees have reviewed the operations of NICEM itself and have made sound suggestions for its operation. They have also conducted two important research activities -- "development of environmental education programs in the agricultural college for the 21st century" and "strategies for improving the status of agricultural environment with special emphasis on livestock waste management", respectively. EERC's research project resulted in a published book "Environmental Education Programs in the Agricultural College for the 21st Century and the Improvement of Agricultural Environment in Korea". The book provides guidelines for developing these programs and was useful when CALS/SNU recently developed its long-term programs.

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[2] The main purpose of the EERC is to ensure that environment-related teaching programs in the agricultural and veterinary colleges are relevant to the major environmental issues being faced in Korea and lead to the production of better-trained environmental professionals.

[3] The main purpose of the ERAC is to ensure that the environmental research programs of the agricultural and veterinary colleges are consistent with the overall environmental policies and priorities of Korea, with special emphasis on rural environmental issues.

C. IMPLEMENTATION RECORD AND MAJOR FACTORS AFFECTING THE PROJECT

Implementation Record

12. Overall implementation was satisfactory. The Loan was closed on schedule and was fully disbursed with no cancellations and no cost overruns. Efficient implementation during the later years made up for the slow start at the beginning of the project.

13. This was especially true for NICEM. NICEM's institutional development was one of the main project objectives, and the project was rated "unsatisfactory" in 1994 when a freeze by the GOK's Cabinet on all organizational changes in Government entities meant that NICEM could not be legally established under the SNU. Without legal status, NICEM was faced with implementation problems such as a shortage of operational budgets and staff and a lack of facilities to house the project equipment as required by a Loan covenant. As a result, NICEM's procurement and research activities came to a halt. After NICEM was legally established at SNU in March 1996 its procurement and research activities moved forward.

14. Procurement activities were completed on time despite a slow start due to loan allocation disagreements among the project colleges. These were eventually solved and the resulting equipment lists were approved by MOE with the help of relevant technical committees. Procurement was handled by the GOK's experienced central procurement agency, SAROK, and nearly all items were purchased through ICB. All procurement procedures were in compliance with Bank procurement guidelines including the purchasing of library materials for NICEM. No irregularities have been found.

15. Audit reports were submitted on schedule throughout the implementation period. After NICEM's legal status was established in 1996, and it became fully operational, all four legal covenants were in full compliance.

Major Factors Affecting the Project

16. There were no major problems affecting the project other than the initial problems encountered by NICEM (para. 13).

Consulting Services

17. A total of 45 short-term foreign experts from 11 countries were hired through NICEM. This number was higher than originally planned although the total staff months experts actually spent in Korea was about the same as planned (Table 5). The experts conducted relevant workshops and seminars and lectured at the various agricultural and veterinary colleges. Some of the foreign experts contributed to NICEM's research activities. Both the visiting expert program and the overseas training provided excellent opportunities for scientists in Korea to establish international collaboration in their research activities.

D. PROJECT SUSTAINABILITY

18. The GOK has a very clear understanding of the environment problems in both rural and urban areas that have resulted from Korea's three decades of rapid growth. The GOK's continuous support for this project and for the Environmental Technology Development Project (Loan 3694-KO) are obvious indications of its awareness in these areas.

19. Over the years the GOK has enacted several wide-ranging laws to help protect Korea's environment and conserve its natural resources and has provided policy and planning guidance on environmental issues by upgrading the EA to a Cabinet-level ministry, MOEN (para. 4). The GOK has thus made a long-term commitment to solving Korea's environmental problems.

20. The research equipment financed by this project is well-maintained and managed and is highly utilized. Proposals for future management of the equipment have been requested by the MOE and these are under preparation by the project institutions. The national budget for 1999 provides funds for the operation and maintenance of this equipment. Continued support for equipment will also be given in 1999 to all higher education institutions in Korea for their research and education programs, and such budgets will be continued in future for all the institutions.

21. NICEM has become a success. Its staff has expanded from 7 in 1993 to 26 (21 professionals and 5 administrative staff) plus 10 graduate student assistants at the end of 1998. Its operations are highly regarded among the agricultural and veterinary colleges and the small and medium private enterprises it serves, and it has also achieved a satisfactory national reputation as a research support institute. In addition to its increased budget, NICEM has secured financing from other sources such as competitive grants from the Korea Science and Engineering Foundation, the SNU, the MOE and various private companies, as well as from user fees and from its symposia and workshops. A new space for the Center is planned for construction at SNU's Seoul campus and will be completed in 2003 allowing the Center to be consolidated from its current four locations.

22. EERC and ERAC are also expected to continue to review and advise both the NICEM and the agricultural and veterinary colleges on their environment-related research activities and teaching programs.

23. All of these factors assure project sustainability.

E. BANK GROUP PERFORMANCE

24. Overall Bank performance was highly satisfactory. Efficiency was gained during the preparation stage by combining the preparation of this project with preparation of both the Environmental Technology Development Project (Loan 3694-KO) and the Science and Technical Education Project (Loan 3693-KO). As a result, a clear understanding of sector-related policy issues, relating especially to the environment was developed from the beginning of the projects.

25. Economies of scale were achieved during implementation by fielding a single Bank mission to supervise all on-going education projects in Korea at the same time. Supervision work was well-coordinated, detailed and cost-effective. An early project launch workshop to smooth project execution, conducted by an experienced implementation consultant, was money well-spent.

F. BORROWER PERFORMANCE

26. Overall Borrower performance was also satisfactory. The impressive performance by the project institutions, especially by NICEM during the later years of implementation, has totally erased the image of a very early "unsatisfactory" rating due to delayed compliance with one legal covenant (para. 13). The Borrower's subsequent performance has to be called highly satisfactory as the project achieved its objectives and the Loan was fully disbursed with no cancellations and no shortages of counterpart funds.

27. This is the first education loan to Korea that has reached full disbursement. Good working relationships between the Bank and the Borrower, efficient coordination by MOE and the efforts made by the project colleges and NICEM were all important factors in the successful implementation as was the trouble-free equipment procurement undertaken by SAROK.

G. ASSESSMENT OF OUTCOME

28. Overall project development objectives were successfully achieved. Performance indicators (Table 6) were identified and monitored by the Bank during the 18 months prior to Loan Closing. Most of the targets were met or exceeded. The research capabilities of the project colleges of agriculture and veterinary sciences have been enhanced, and research activities and publication of their findings have increased steadily over the projects years and are being used by related private enterprises (para. 10). A centrally located common research facility, NICEM, was established and is in full operation with adequate budgetary and financial support (paras. 8, 20 and 21). Committees for review of research activities and teaching programs related to the environment, EERC and ERAC, were established and have been functioning since 1993 (paras.11 and 22).

H. FUTURE OPERATION

29. Korea graduated from borrower status in June 1995; however, due to the recent financial crisis in the East Asia region, the GOK has asked for some structural adjustment and technical assistance loans.

I. KEY LESSONS LEARNED

30. The lesson to be learned from this project is that frequent and detailed supervision as well as good working relationships with the Borrower can save a project and even turn around an "unsatisfactory" rating.

PART II : STATISTICAL INFORMATION

Table 1: Summary of Assessments

A. Achievement of Objectives	Substantial (✓)	Partial (✓)	Negligible (✓)	Not applicable (✓)
Macro Policies	☐	☐	☐	☒
Sector Policies	☐	☒	☐	☐
Financial Objectives	☐	☐	☐	☒
Institutional Development	☒	☐	☐	☐
Physical Objectives	☒	☐	☐	☐
Poverty Reduction	☐	☐	☐	☒
Gender Issues	☐	☐	☐	☒
Other Social Objectives	☐	☐	☐	☒
Environmental Objectives	☒	☐	☐	☐
Public Sector Management	☐	☒	☐	☐
Other - Private Sector Development	☐	☐	☐	☒

B. Project Sustainability	Likely (✓)	Unlikely (✓)	Uncertain (✓)
	☒	☐	☐

(Continued)

C. Bank Performance	Highly satisfactory (✓)	Satisfactory (✓)	Deficient (✓)
Identification	☒	☐	☐
Preparation	☒	☐	☐
Appraisal	☒	☐	☐
Supervision	☒	☐	☐

D. Borrower Performance	Highly Satisfactory (✓)	Satisfactory (✓)	Deficient (✓)
Preparation	☒	☐	☐
Implementation	☐	☒	☐
Covenant Compliance	☐	☒	☐
Operation (if applicable)	☒	☐	☐

E. Assessment of Outcome	Highly satisfactory (✓)	Satisfactory (✓)	Unsatisfactory (✓)	Highly unsatisfactory (✓)
	☒	☐	☐	☐

TABLE 2: Related Bank Loans/Credits

Loan/credit title	Purpose	Year of approval	Status
Preceding operations			
1. First Education (Cr. 151-KO)	Expansion of vocational high schools (VHSs), junior technical colleges and teacher training	1969	Completed 09/76
2. Second Education (Ln. 906/Cr. 394-KO)	Improvements in VHSs, junior technical colleges and science, engineering and education colleges	1973	Completed 12/79
3. Third Education (Ln. 1096-KO)	Expansion and quality improvement in vocational high schools, junior colleges and vocational training institutes (VTIs)	1975	Completed 11/81
4. Vocational Training (Ln. 1474-KO)	Further expansion of VTIs and expansion and improvement of instructor training	1978	Completed 06/83
5. Sector Program on Higher Technical Education (Ln. 1800-KO)	Improving technical colleges and colleges of engineering and management through supply of equipment, staff development, manpower planning, equipment maintenance and academic accreditation	1980	Completed 02/86
6. Program for Science and Technology Education (Ln. 2427-KO)	Raising quality of science and technology education to standards required by a more skill- and knowledge-intensive industrial system through planned policy and institutional changes	1984	Completed 06/89
7. Technology Advancement (Ln. 3037-KO)	Strengthening the development of SMIs in technology-intensive sectors, improving the quality of education in a center of excellence in science and engineering education and enhancing the capacity of selected R&D institutions to provide technical support for SMIs	1989	Completed 12/31/93
8. Second Technology Advancement (Ln. 3202-KO)	Improving the research capacity of one leading graduate school in science and engineering and enhancing R&D capacities in the areas of biotechnology, basic and industrial standards, and energy and resource utilization	1990	Completed 06/30/94

Loan/credit title	Purpose	Year of approval	Status
9. Science and Technology Research (Ln. 3203-KO)	Enhancing basic research programs in selected universities in priority fields in science and technology and improving science teacher training	1990	Completed 12/31/95
10. Vocational Education (Ln. 3314-KO)	Upgrading the skill training provided in selected vocational high schools meeting the increasing complex skill requirements of industry, commerce, agriculture and fisheries	1991	Completed 06/30/96
11. Third Technology Advancement (Ln. 3315-KO)	Improving the quality of research programs for developing advanced technologies, increasing opportunity for joint basic science research activities through common research facilities; and enhancing the development and application of industrial standards	1991	Completed 06/30/94
12. Science Education and Libraries Computerization (Ln. 3468-KO)	Raising the quality of science programs in secondary schools and universities and establishing an interlibrary network system to enhance the access of information to students, faculty and researchers	1992	Completed 12/31/97
13. Vocational Schools Development (Ln. 3469-KO)	Continuing with the objectives of Ln. 3314-KO to upgrade skill training in selected VHSs and strengthening VHS systems through five studies in five agreed areas	1992	Completed 12/31/97
Following operations			
14. Environmental Technology Development (Ln. 3694-KO)	Strengthening: (a) selected national research institutes to identify and adequately address environmental issues and to undertake environmental R&D activities; and (b) the Ministry of Environment's policy and planning role	1994	Completed 9/30/98
15. Science and Technical Education (Ln. 3693-KO)	Improving science and technical education and research through implementation of an agreed policies and actions program and the provision of specialized equipment	1994	To be completed 12/31/99

Table 3: Project Timetable

Steps in Project Cycle	Date Planned	Date Actual/ Latest Estimate
Identification	-	02/23/92
Preparation	-	07/26/92
Appraisal	-	11/15/92
Negotiations	-	04/05/93
Board Presentation	-	06/03/93
Signing	-	06/30/93
Effectiveness	09/03/93	09/03/93
Project Completion	06/30/98	06/30/98
Loan Closing	12/31/98	12/31/98
Last Disbursement	-	03/08/99
Cancellation of Remaining Funds 1/	-	-

1/ 100% disbursed.

Table 4: Loan/Credit Disbursements: Cumulative, Estimated and Actual

(US$ million)

Cumulative Disbursements	FY94	FY95	FY96	FY97	FY98	FY99
Appraisal Estimate	4.0	16.0	38.0	53.0	59.0	60.0
Actual	0.0	4.0	12.5	30.6	49.6	60.0
Actual as % of Estimate	0%	25%	33%	58%	84%	100%
Date of Final Disbursement					March 8, 1999	

Table 5: Key Indicators for Project Implementation

Key Implementation Indicators in the SAR/President's Report

		In 1994 estimated	By 1999 actual
(a)	Loan proceeds by components (in million)		
	NICEM	$12.3	$12.7
	Agricultural Colleges	$34.7	$34.5
	Veterinary Colleges	$13.0	$12.8
	Total	$60.0	$60.0

	Category	Appraisal Person/Staffmonth	Actual Person/Staffmonth
(b)	Overseas Training	70/420	150/410
(c)	Visiting Experts	12/54	45/50

Table 6: Key Indicators for Project Operation

1. The project would assist selected colleges of agriculture and veterinary sciences to upgrade their capacities to undertake research into key environmental problems.

Impact Indicator:

1.0 Over the duration of the project, the colleges will initiate research in the projects identified during project preparation and documented in the project file (baseline year = 1993). 30% were to be initiated by 1996, 70% by the ICR year, 100% by the full impact year – 1999.

Finding: Goals have been fully met – 89% were initiated by 1996 and 179% by 1998.

Output Indicators:

1.1 Library facilities will be established (baseline year = 1993). 30% were to be completed by 1996, and 100% by the ICR year.

Finding: Complete.

1.2 Staff skills and knowledge will be upgraded as per implementation plan (baseline year = 1993).

Finding: Complete

1.3 Research facilities will be upgraded with equipment as per implementation plan (baseline year = 1993). 30% were to be procured and installed by 1996, and 100% by the ICR year.

Finding: Complete

2. The Project will establish facilities for effective common research activities.

Impact Indicator:

2.0 NICEM was to be established and fully operational by the ICR year.

Finding: Complete

Output Indicators:

2.1 NICEM was to be formally incorporated as part of SNU by 1996.

Finding: Complete; NICEM was legally established as part of SNU in March 1996

2.2 Library facilities will be established as per implementation plan with 30% to be complete by 1996, and 100% by the ICR year.

Finding: Complete

2.3 Staff skills and knowledge will be upgraded as per implementation plan.

Finding: Complete

2.4 Research facilities will be upgraded as per implementation plan.

Finding: Complete

2.5 Advisory committees to be established within the first two years.

Finding: Complete

3. The Project will reinforce the environmental aspects of basic science programs in the colleges, in order to strengthen professional training in environmental fields.

Impact Indicator:

3.0 Improved curricula and staff participation will be integrated into basic science programs of the colleges with 50% integrated by the ICR year, 100% by the impact year – 1999.

Finding: estimated 50% integrated

Output Indicator:

3.1 The Environmental Education Review Committee was initially established within the first two years and was fully established and operational by 1996.

Finding: Fully established and operational

4. The Project will establish appropriate arrangements for the review of the environment-related research and the teaching programs.

Impact Indicator:

4.0 There will be an increasing number of environment-related research activities initiated to increase by 10% by 1996, and 30% by the ICR year.

Finding: Target already met

Output Indicator:

4.1 The Environment Research Advisory Committee was initially established by 1996, and was fully established and operational by the ICR year.

Finding: Fully established and operational

Table 7: Research Activities, Publications and Patent Awards Resulting from the Project

	Research Activity		Publications			
Project Year	Original	Actual	Published Internationally and Domestically	Environment-Related Papers	Used by Related Industries	Patent Awards
1993	303	493	473	135	53	1
1994	604	785	777	232	69	4
1995	597	1,095	1,094	256	104	9
1996	835	1,651	1,622	338	284	46
1997	1,145	2,218	2,118	481	356	43
1998	1,051	1,872	1,755	408	359	35
Total	4,535	8,114	7,839	1,850	1,225	138

Table 8A: Project Costs

	Appraisal Estimate (US$M)			Actual (US$M)/1		
Item	Local Costs	Foreign Costs	Total	Local Costs	Foreign Costs	Total
1. Equipment	-	58.4	58.4	3.7	58.6	62.3
2. Equipment transportation and installation	3.1	0.4	3.5	2.5	-	2.5
3. Operations and maintenance	8.2	0.9	9.1	2.7	-	2.7
4. Consumable materials	8.2	0.9	9.1	1.4	-	1.4
5. Overseas training	0.1	0.9	1.0	-	1.0	1.0
6. Visiting experts	0.1	0.6	0.7	-	0.3	0.3
7. Library materials	-	0.1	0.1	-	0.1	0.1
8. Contingencies	5.2	10.2	15.4			
TOTAL	24.9	72.4	97.3	10.3	60.0	70.3

/1 The Borrower's submission dated February 9, 1999.

Table 8B: Project Financing

	Appraisal Estimate (US$M)			Actual (US$M)[1]		
Source	Local Costs	Foreign Costs	Total	Local Costs	Foreign Costs	Total
IBRD	-	60.0	60.0		60.0	60.0
Domestic Contribution	24.9	12.4	37.3	10.3	-	10.3
TOTAL	24.9	72.4	97.3	10.3	60.0	70.3

1 The Borrower's submission dated February 9, 1999.

Table 9: Economic Costs and Benefits

Not Applicable

Table 10: Status of Legal Covenants

Agreement	Section	Covenant type	Present status	Original fulfillment date	Revised fulfillment date	Description of Covenant	Comments
Ln 3612-KO	3.03	5	C	Undated	NA	Maintain NICEM with adequate staff and with structure, functions, facilities and budget acceptable to the Bank.	Fulfilled, NICEM was legally included in SNU as of March 1996.
	3.04	5	C	Undated	NA	Cause NICEM to implement programs on overseas training and visiting experts in accordance with an agreed-upon timetable.	Fulfilled
	3.05	5	C	Sept.30, 1993		Maintain, through MOE, EERC and ERAC with structure, functions and membership acceptable to the Bank and hold first meeting before 09/30/93.	Fulfilled
	4.01	1	C	June 30 of each year		Furnish to the Bank audit report including separate opinion on SOEs not later than June 30 of each year.	Fulfilled

Notes: (a) Covenant type (only for those used in this table)

5 Management aspects
1 Accounts/audit

(b) Status (only for those used in this table)

C Complied with

Table 11: Compliance with Operational Manual Statements

No evidence of non-compliance with applicable Bank manual statements observed.

Table 12: Bank Resources: Staff Inputs

Stage of Project Cycle	Planned		Revised		Actual	
	Weeks	US$(000)	Weeks	US$(000)	Weeks	US$(000)
Through Appraisal	-	-	-	-	26.4	83.0
Appraisal	-	-	-	-	4.1	13.9
Negotiations through Board Approval	-	-	-	-	3.3	11.5
Supervision	21.1	86.9	21.4	86.9	28.2	106.3
Completion	7.0	13.0	7.0	13.0	7.0	13.0
TOTAL	-	-	-	-	69.0	227.7

Note: No or incomplete MIS or COS data for the planned or revised in staff weeks and in dollars.

Table 13: Bank Resources: Missions

Stage of Project Cycle	Month/ Year	Number of Persons	Days in Field	Specialized Staff Skills Represented	Performance Rating		Types of Problems
					Implementation Status	Development Objectives	
Through Appraisal	2/23-3/5/92	4	25	Econ./Impl. Spec./Sci. Educ./Environ. Specialist			
	7/23-8/13/92	4	27	Econ./Imple. Spec./Sci. Educ./Environ. Specialist			
Appraisal through Board Approval	11/15-12/5/92	4	40	Econ./Impl. Sepc./Sci. Educ./Environ. Scientist.			
Project Launch	7/3/93	2	2	Impl. Specialist/ Voc. Trg Spec.	NR	NR	
Supervision	10/31-11/13; 11/24-12/1/93	3	13	Econ./ Impl. Spec./Sci.Spec.	HS	HS	
	6/26-7/16/93	2	8	Impl.Spec./Voc. Trg.Spec.	HS	HS	
	11/13-12/3/94	3	13	Impl.Spec./Voc. Trg.Spec./ Sci. Specialist	S	U	NICEM's legal status in SNU was held up by GOK organization freeze and resulted in shortage of funds and staff, and slowed construction of new building.
	6/18-7/8/95	3	13	Impl.Spec./Voc. Trg. Spec./ Sci. Specialist	S	HS	
	11/5-12/3/95	3	18	Impl.Spec./Voc. Trg. Spec./Sci. Specialist	S	HS	
	5/13-6/1/96	2	8	Tech. Educ./ Impl. Spec.	S	HS	
	10/28-11/16/96	3	13	Tech. Educ./ Impl. Spec./ Sci. Specialist	S	HS	
	5/18-6/6/97	2	14	Tech. Educ./ Imple. Spec.	S	S	
	5/3-5/19/98	2	10	Op. Analyst/ Imple. Spec.	HS	HS	
Completion	10/28-11/15/98	1	10	Ops. Analyst	HS	HS	

Ratings: S - satisfactory, HS - highly satisfactory, U – unsatisfactory; NR – Not Rated

REPUBLIC OF KOREA

IBRD Progress Review Mission for
Environmental Research and Education Project – Loan 3612-KO

Aide Memoire [1]/

1. The IBRD Mission [2]/ visited Korea from October 28 to November 12, 1998, to review the implementation progress of two World Bank financed projects (Lns. 3612-KO and 3693-KO), and to follow up on the status of special accounts and evaluation summaries of a recently completed project (Ln. 3694-KO). This Aide Memoire will only address Loan 3612-KO, because the final Aide Memoire has to be included in its Implementation Completion Report (ICR). A separate Aide Memoire is being prepared for Ln. 3693-KO.

2. During the course of its review for this project, the mission visited the Ministry of Finance and Economy (MOFE), Ministry of Education (MOE), the Supply Administration, Republic of Korea (SAROK), the College of Agriculture, Cheju National University, Colleges of Agriculture, and Veterinary Medicine, Chungnam National University, Colleges of Agriculture and Life Science (CALS), and Veterinary Medicine, Seoul National University, and the National Instrumentation Center for Environmental Management (NICEM). The mission would like to take this opportunity to express its appreciation for the kind hospitality and assistance extended to the mission especially from the Director of NICEM, Dr. Eunwoo Park.

Summary of Procurement and Disbursement

3. The mission received two status reports, one from Ministry of Education (MOE) and one from NICEM. The Overall progress was generally satisfactory. The status of procurement and disbursements planned and achieved are summarized in Attachment 1. Based on data collected as of September 30, 1998, which is three months before the Closing Date (December 31, 1998), procurement has reached 96% and disbursements has reached 86% of the total loan amount. The low disbursement rate (as of September 30, 1998) is because several large contracts are still in the process of being disbursed. An updated version of procurement and disbursement will be provided to the Bank shortly.

Field Visits Findings

4. **NICEM.** The mission found operations in NICEM very impressive. Not only adequate spaces have been added to house the additional project equipment, but proper locations for highly sensitive equipment are being taken into consideration during the planning. The Director has secured annual national budget from the government as well

[1] / This Aide Memoire is subject to the review and modification by Bank Management.
[2] / The mission comprised Ms. Carol H.L. Ball (Task Team Leader, EASED).

as other grants to fund the operations of NICEM. So far, there is no shortage of staff, laboratory consumer materials, and operations and maintenance costs. NICEM has established a network of equipment repairing and maintenance team with the suppliers. The utilization rate of NICEM's equipment is very high. Some of their own research projects will have to be conducted after hours, due not only to the high equipment utilization rate but also to the frequent demand for their services by other institutions, including the private sector. Their environmental research publications has been increasing annually.

5. The implementation of overseas training and visiting experts programs has been completed. There is a saving of US$.3 million, which has been used to procure needed equipment.

6. **Colleges of Agriculture and Veterinary Medicine**. Colleges visited by the mission show no indication of shortage of counterpart funds for operations and maintenance. All equipment items procurement under the project are well managed and properly housed. The equipment utilization rate varies depending on the specialization of the equipment. Generally, they are all being used either by the research faculties or their graduate students. At times, the general public also come and use the equipment, and a small user's fee is charged for consumable materials. The number of research topics has increased yearly and most of them are environment related. Research findings have been published in both national and international journals.

Unused Loan Proceeds by Closing Date

7. MOE informed the mission that there would not be any significant amount of unused loan proceeds by the time of the Closing Date. The mission pointed out that there will be no need for an extension of the Closing Date.

8. NICEM would like to use any leftover funds by other project institutions to buy some more library materials using the international shopping procedures. The Bank normally would have no objection to any transfer of a small percentage of loan funds between project institutions and between categories of expenditures at a time near a loan's closing date, as long as the project's development objectives are not adversely affected and the relevant contracts signed and payments due prior to the closing date.

Matters Related to Implementation Activities at the Time Near the Closing Date

9. At a late stage of project implementation, ICB and NCB procurement procedures are not suitable, because the lead time is too long. More suitable procurement procedures are prudent shopping for equipment, and direct negotiations with suppliers for library materials. The lead time for either is short.

10. In order to be "eligible for disbursement", it is crucial to note that all payment due dates including expiry dates of L/Cs have to be before the Closing Date. A suitable disbursement procedure to be used at a late stage of project implementation is "Direct Payment to Suppliers" for which Form 1903 should be used. This would obviate two difficulties: (i) the use of Special Commitment would involve the issuance of a Letter of

Credit (L/C), for which the expiry date may be after the Closing Date, the Bank would not honor such L/Cs; and (ii) the Special Account (SA) used may not have a balance great enough for the transaction during the SA recovering period near the Closing Date.

11. Sometimes payments on eligible expenditures could not be paid on time before the Closing Date. The Bank, however, could grant a grace period of four months after the Closing Date to facilitate such payments. The Bank would usually agree to this request, if asked for and recommended by the mission. MOE has submitted such request to the mission. The mission will seek the approval of Bank management upon return to headquarters.

12. In order to be eligible for reimbursement, all contracts payment due dates and L/Cs' expiry dates have to be before the Closing Date. Any payment due within the Grace Period is **NOT** eligible for reimbursement by the loan account. The Grace Period, which the loan account will remain open for another "four months" after the Closing Date, is only for the purpose of processing disbursement paperwork.

Review of Bid Evaluation Reports and Contract Awards

13. During the visit to SAROK, which has recently moved to a new government office complex in Taejon, the mission reviewed all bid evaluation reports and contract awards under this review period, totaling about 115 bids. No irregularities were found. All awards were made to the lowest evaluated bids. SAROK's performance is highly satisfactory.

14. The mission would like to call the attention of SAROK regarding the Closing Date matters stated in the above paras. 9 to 12.

Review of Statement of Expenditures and the Supporting Vouchers

15. The mission's review covered about 10% of MOE's entries in their 6 Applications for Withdrawal (AFWs), totaling about 58 items. All the supporting vouchers matched with the entries of the SOEs. The review indicated satisfactory project administration of MOE.

Covenant Compliance

16. All covenants in the Loan Agreement were in full compliance. The final audit report covering the period of January 1 to December 31, 1998, should be submitted to the Bank as soon as possible but no later than June 30, 1999.

Settlement of the Special Account

17. Either AFWs or the refund of the balance of the Special Account should be done in order to settle the Special Account with our Disbursement Division. Refund should be sent to the following World Bank account:

Federal Reserve Bank of New York

33 Liberty Street, NY, NY 10045, USA
Account IBRD A-General ABA no. 210-8138-3
Attention: Foreign Department
Reference: IBRD Loan 3612-KO, SA Refund

Preparation of ICR

18. It is the Bank's policy to prepare the ICR for each project after its Closing Date. The purpose is to evaluate the success or failure of the project. Whether the development objectives had been achieved as anticipated. Is there a cost- or time- overrun? What is the performance of the Borrower and of the Bank during the implementation of the project? Is the project sustainable after its completion? What are the measures taken by the Borrower to make it sustainable? What are the lessons learned for the Borrower and the Bank? For example, is it worth replicating in other developing countries?

19. For achieving the above tasks, efforts from both the Bank and the Borrower are needed. An ICR preparation document (Attachment 2) was prepared by the mission, and presented to MOE and NICEM. Extensive discussions were conducted and the draft was approved during these meetings. An ICR preparation timetable was also agreed upon and attached to the above document.

Y2K Problem

20. Due to the approach of the year 2000. All electronic computer equipment and software using the two digits in the year field are in serious jeopardy. Any work or services linked to the time system using the two digit system could be disrupted. The mission has alerted MOFE, MOE, NICEM and project institutions visited by the mission the Y2K problem. They are well aware of the situation and the seriousness of the Y2K problem. The mission was informed by MOE, that the Ministry of Information and Communication under the direction of the Prime Minister is looking into the Y2K problem. Seoul National University is also looking into this problem, but waiting for the Government's recommendation. MOFE informed the mission that there is a budget of Won 4,000 billion set aside by the Government of Korea for the Y2K problem. The mission observed that everybody including the project institutions is well aware of this problem, but still there are no concrete solutions. Attachment 3 is attached to this Aide Memoire to help all concerned parties, including SAROK, to understand the nature of the Y2K problem. Further information could be obtained from the World-Wide Web: http://www.year2000.com/cgi-bin/y2k/year2000.cgi.

21. **Next Mission**. There will be no more progress review missions from the Bank for this project, as the Closing Date is December 31, 1998.

November 11, 1998

CC:

Ministry of Finance and Economy — Fax No. 82-2-503-9282
Mr. Kang, Jung Young
Director, Treasury Division
Treasury Bureau

Ministry of Education — Fax No. 82-2-735-7682
Mr. Lee, Gi Woo
Director General
Education Environment Improvement Bureau

Mr. Kim, Gi Nam — Fax No. 82-2-730-6068
Director
Education Facilities Division
Education Environment Improvement Bureau

NICEM
Mr. Park, Eun Woo — Fax No. 82-331-295-2197
Director
Seoul National University, Suwon

Supply Administration, Republic of Korea — Fax No. 82-2-533-0711
Mr. Lee, Sung Lun
Director
Foreign Procurement II

KOREA
Procurement and Disbursements Status
Environmental Research and Education Project, Loan 3612-KO
(October 28 - November 12, 1998)

Loan No.	Project Institutions	Loan Amount (US$ millions) (A)	Procurement (US$ millions) Request to SAROK & TA	To Be Sent	Contracts Awarded (B)	Percent of Loan (B/A)	Disbursements (US$ millions) Disbursed	Percent of Loan	Remark
3612-KO		60.0	63.3	-	57.3	96%	51.8	86%	improved from 76% last report
	(a) Colleges of Agri.	34.7	36.7	-	32.5	94%	----	----	
	(b) Colleges of Vet.	13.0	13.7	-	12.5	96%			
	(c) NICEM /a	12.3	12.9	-	12.3	100%	----	----	additional funds may be reallocated.

Source: Latest Status Reports given to the mission in the field as of September 30, 1998.
/a NICEM = National Instrumentation Center for Environmental Management; it includes US$1.5 million for overseeas training and experts services for which US$1.2 million has been disbursed.

Environmental Research and Education Project
Loan 3612-KO

ATTACHMENT 2

The Preparation of Implementation Completion Report (ICR)
Closing Date: December 31, 1998

1. What is an ICR?

The ICR is a milestone in the project cycle, marking the transition from implementation to the project's future operation. It assesses primarily (a) the degree of achievement of project objectives; (b) prospects for the project's sustainability; (c) Bank and borrower performance; (d) project outcome; and (e) the plan for the project's future operation.

2. Who wants an ICR?

The policy of the Bank is to evaluate completed projects, and it requires borrowers also to do so. The Bank requires an Implementation Completion Report (ICR) for each lending operation it finances.

3. Why is an ICR needed?

An ICR is needed for a number of reasons as follows:

Transparency - The Bank wants every project that it finances to be fully transparent to all interested parties.

Accountability - All the loan proceeds must be accountable, i.e. we must show that they were disbursed in accordance with the objectives of the project and in line with the requirements of the Loan Agreement.

Benefits - Each project's designed benefits, achieved, partly achieved or not achieved, need to be explained.

Lessons Learned - For future operations, the Bank tries to avoid/diminish mistakes and replicate successes.

Evaluation - Only through an impartial evaluation, can we determine the extent to which project objectives have been achieved.

Sustainability - It is important for the Bank and borrower to assess whether objectives are sustainable, based on good reasons and a future plan.

4. What is in the ICR?

An ICR Table of Contents sample (Annex 1) is attached for your reference.

5. Who is responsible for preparing the ICR?

Both the Bank and the borrower are responsible for preparing the ICR:
(a) The ICR is prepared by a completion mission of the Bank. The mission's Aide Memoire is included in the ICR as its Appendix A; and

(b) The borrower prepares and makes available to the Bank its own evaluation report on the project's execution and initial operation, cost and benefits, the Bank's and borrower's performance of their respective obligations under the Loan Agreement, and the extent to which the purposes of the loan were achieved. A summary of this report (or the full report if it is ten pages or less) is annexed unedited to the ICR. The borrower also (i) adopts a plan acceptable to the Bank for the operational phase of the project, and (ii) assists the Bank in ICR preparation. A questionnaire for the preparation of ICR and required financial tables (Annex 2) are attached to be submitted to the Bank according to the ICR time schedule.

6. When is the ICR due?

The ICR is normally distributed to the Bank's Board of Executive Directors not later than six months after the Project's Closing Date. A time schedule (Annex 3) is attached for your reference.

Matters Related to a Project Near its Closing Date

7. What is eligible for disbursements ?

All goods and services, whose payments including letters of credit (L/Cs) **with expiry date before the Closing Date** are eligible for reimbursement.

8. What is Grace Period?

In accordance with the present practices in the Bank, and with the concurrence of the Bank's sector manager, the loan account could remain open for another **four months** after the Closing Date. It is **only for the purpose of processing disbursement paperwork**. This four-month period is called the **"Grace Period"**. Any procurement payment made or due within this Grace Period is **not** eligible for reimbursement.

9. What other procurement methods could be used in order to procure goods quickly before the Closing Date?

Schedule 4 of the Loan Agreement allows prudent shopping procedure to be used for contracts costing less than $300,000 or less per contract with three price quotations from at least three suppliers. Library materials could use the direct contracting procedures without competition (single source).

10. Why use the direct payment or reimbursement procedures when Closing Date is near?

Our disbursements department already starts to recover the funds in the special account, so direct payment procedure should be used when Loan is near its closing. Or if GOK could advance its own fund to make payments on eligible expenditures, reimbursement could be made during the Grace Period from the Bank to GOK (limited, however, by the total Loan amount).

ANNEX 1

TABLE OF CONTENTS

Republic of Korea

Environmental Research and Education Project (Loan 3612-KO)

Questionnaire for the Preparation of Implementation Completion Report (ICR)

All questions related to the project cost should be answered regardless of financing sources, i.e. whether by the Loan or by local contributions (government or project institutions).

Implementation Result

1. What is the result of equipment procurement?

(a) total amount of loan used
(b) number of items of equipment purchased
(c) comparison with original estimate for each of the above
(d) any major changes compared with the original plan (quantity, major specification changes, unit cost estimate, reasons for the change)
(e) any cost overrun
(f) completion dates of equipment procurement, and any time overrun
(g) any major problem encountered
(h) comments on quantity (adequacy in terms of need), quality (meeting users' requirements), and management
(i) Is there any delivery delay, delivery shortage, delivery mistake (e.g. wrong specifications), non-responded claims, forfeiture of bid bonds/performance bonds and any needed legal action?

2. Was there any civil works built for housing project equipment?

(a) total area built: actual and original plan (specify the part for project equipment, and the part for other purposes, if possible)
(b) total cost: actual and original plan
(c) comment on adequacy for equipment housing
(d) completion date and any time overrun

3. What is the result of fellowships and visiting experts implementation?

(a) number of fellowships and staff-months: actual and original plan
(b) number of visiting experts and staff-days: actual and original plan
(c) comments on usefulness of the fellowships and visiting experts
(d) any major problems encountered
(e) any major contributions of the visiting experts

4. What are your comments on project implementation? Your institution? Your ministry?, SAROK? and the Bank?

5. What are your overall comments on the project, any major contribution to your institution?

Quantitative and Qualitative Achievements

1. **How many research topics were newly undertaken by year (1993, 1994, 1995, 1996, 1997 and 1998, actual/estimate)?**

2. **Within which (refer to above figure), how many are environmentally related? (Answers for questions 1 and 2 could be presented in one table.)**

3. **Within the same time period (see question 1 above), how many environmental research results were published domestically and/or internationally?**

4. **How many research results were used by industry?**

5. **If any, how many patents have been received?**

Management Indicators

1. **What is the average utilization rate of equipment purchased by this project?**

2. **Is there any domestic budgetary problem?**

3. **Is there any deficiency in the Bank's performance?**

4. **Summarize the impact of the project in general.**

Future Sustainability Plan

1. **Any institutional project sustainability plan?**

2. **Any governmental project sustainability plan?**

3. **Any foreseen Year 2000 related problems, e.g. computer software or hardware disruption problems?**

4. **If yes, are there any appropriate institutional or national Y2K problem prevention programs? Please be specific.**

Project Cost and Financing Tables

Please see attached table formats.

SAR Table 3.1: Summary of Project Costs by Component

	Appraisal Estimate (US$M)			Actual Costs (US$M)		
Component	Local Costs	Foreign Costs	Total	Local Costs	Foreign Costs	Total
NICEM						
Agricultural Colleges						
Veterinary Colleges						
Total						

SAR Table 3.2: Summary of Project Costs by Expenditure

	Appraisal Estimate (US$M)			Actual Costs (US$M)		
Component	Local Costs	Foreign Costs	Total	Local Costs	Foreign Costs	Total
Equipment						
Equipment transportation and installation						
Operations and Maintenance						
Consumable Materials						
Overseas Training						
Visiting Experts						
Library Materials						
Total						

SAR Table 3.3: Financing Plan

	Appraisal Estimate (US$M)			Actual Costs (US$M)		
Source	Local Costs	Foreign Costs	Total	Local Costs	Foreign Costs	Total
IBRD						
Domestic Contribution /a						
Total						

/a Please include all national funds, i.e. grants and national budgets.

REPUBLIC OF KOREA

Environmental Research and Education Project, LOAN 3612-KO
Closing Date: December 31, 1998

ICR Preparation Schedule

Bank Side Step Name	Date
(a) Time Schedule - Steps and Dates	
1. Project Completion Mission	Oct./Nov. 1998
2. ICR Drafting	3/01/99 - 4/01/99
3. Draft ICR to reach MOE	4/1/99
4. Gray Cover ICR Preparation	4/1/99 - 5/31/99
5. ICR to Bank Board	6/30/99
6. Final ICR to Institutions & GOK	8/30/99

Ministry of Education Side Step Name	Date
(a) Time Schedule - Steps and Dates	
1. ICR Data Collection	11/16/98 - 1/31/99
2. Replies to the Questionnaire, Documents & Tables to reach Bank	by 2/15/99
3. Preparation of Evaluation Summary	11/16/98 - 3/1/99
4. Evaluation Summary to reach Bank	by 3/1/99
5. Comments on Draft ICR to reach Bank	by 4/30/99

(b) List of Documents and Tables to be sent to the Bank from Institutions

1. The Evaluation Summary to be annexed to the ICR /* (see 3 & 4 above)

2. Questionnaire, Documents and Tables (see 2 above)
(i) Replies ro the questionnaire, or any other consolidated information on the project
(ii) Project cost table
(iii) Project finance table
(iv) Project components starting and completion dates
(v) Plan for future operation, as evidence of sustainability

3. Comments on draft ICR (see 5 above)

/* The following points could be included: (i) a covenant non-compliance related to NICEM; and (ii) any contributions from the two committees - ERAC and EERC.

ATTACHMENT 3

YEAR 2000 (Y2K) Problem

Nature of the Problem

1. The Millennium Software bug or "Y2K problem" is a serious business problem affecting all world economies that is due to strike no later than January 1, 2000. [1]/ It stems from potential erroneous operation of computer software due to date calculation errors related to the year 2000. It can compromise government and infrastructure services, operation of the financial markets, worldwide communications, and business continuity across the economy. Since infected systems can disrupt healthy ones, all institutions must obtain expensive health certificates for their software lest they be excluded from business networks. Even for isolated systems presumed error-free, escalating standards of civil liability force expensive inspection and testing work.

2. Unfortunately, risks are not confined to software systems. In many hardware components ranging from securing devices in buildings to processing control devices and medical equipment there are embedded computer chips with software carrying (often unsuspectedly) Year 2000 problems.

3. Examples of potentially affected systems include telecommunications systems, transportation systems (air, rail, road and shipping), electric power generation and distribution, water and waste treatment, hospital and medical facilities, manufacturing and distribution systems, insurance industry, financial institutions, tax collection, international trade, criminal justice and court systems, civil policy systems, social services, state investment systems and emergency response systems.

3. Given the broad impact of the Y2K problem, the laborious nature of remediation and testing work, and the short time available before the problem strikes, it is indispensable for institutions and countries to focus corrective efforts and resources on the areas of highest risk. Thus in most cases remediation plans must start with an assessment of priorities and include contingency plans for dealing with potential crises.

4. Not all is bleak. The Y2K problem offers a unique opportunity for governments to come to terms with the crucial role of strategic information systems in the economy, thus facilitating rational management of those systems. The Internet is in place to facilitate knowledge sharing on an unprecedented scale. The global nature of the problem is revitalizing altruistic behavior and cooperative solution schemes. National informatics service industries stand to gain a boost from well-designed remediation programs.

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[1] / The error arises from decisions by computer programmers and system designers to use two instead of four digits to represent the year in a data field. Thus, "1965" becomes "65". Much software written before 1995 uses this convention and thus implicitly assumes that dates of the form xx/xx/00 precede dates of the form xx/xx/99 causing wrong answers when comparing dates in the 21st century with those in the 20th. If such a comparison is to test the validity of a credit card, then the credit card may be rejected; if the comparison is to calculate a pay check, then an erroneous check may be issued. A related problem stems from the fact that dates such as 9/9/99 or 12/31/99 were sometimes used in programs or wired into hardware to represent date limits; as we reach the millennium, real dates may indeed be later than these assumed date limits, leading to still more errors. In addition, a leap year occurs in a year ending in 99 only once in 400 years, but the year 2000 is such a leap year; some software will miss February 29, 2000.

Evaluation Summary
of
The Environmental Research and Education Project

(IBRD Loan No. 3612-KO)

February 1999

Ministry of Education
Republic of Korea

Evaluation Summary of the IBRD Environmental Research and Education Project, Loan No. 3612-KO

1. Foreword

1.1 Over the past decade, the Korean Government has begun to address the environmental problems that have emerged from three decades of rapid growth. Wide-ranging legislation has been enacted and agencies have been established to implement this legislation and to provide policy and planning guidance on environmental issues. To reinforce these activities, environmental education has been introduced into primary and secondary schools' curricula and into teacher training. College-level science courses are focusing increasingly on environmental issues and university research programs are also moving in this direction. However, in addressing environmental problems, the focus has been mainly on such problems as they relate to urban areas. Most attention has been given to alleviating air and noise pollution in the cities and towns and to inland water pollution as it affects urban water supply.

1.2 Increasingly, however, rural environmental problems are receiving attention in a densely-populated country with scarce cultivable land and abundant forests at 21% and 66% of total land area respectively. Cultivable land is becoming increasingly polluted through household, industrial and animal waste, and agrochemicals; inland and coastal waters are being polluted in a similar manner. Korea's forests, although extensive, need to be better managed to ensure effective conservation of soils and watersheds, efficient harvesting and replanting, reduction of pest damage and improved tree health, etc. This requires better trained professionals to measure and control pollution, manage forests and fisheries and operate the regulatory system. There is also a priority need to improve and expand research into key environmental problems related to land, water and forests. The agricultural and veterinary colleges have an important role to play in addressing these problems through research and teaching.

1.3 The project has provided the opportunity for the Bank to support Korea's policies for environmental improvement by strengthening environmental research and teaching in selected agricultural and veterinary colleges. The project has helped push the colleges more firmly towards addressing environmental concerns and in accelerating the pace of such involvement. It has also helped bring balance to Korea's environmental efforts, which had a strong urban focus, by strengthening the country's capacity to address rural environmental problems.

1.4 The objectives of the project were to assist selected colleges of agriculture and veterinary science to: (a) upgrade their capacity to undertake research into key environmental problems; (b) establish facilities for effective common research activities; (c) reinforce the environmental aspects of basic science programs in the colleges, in order to strengthen professional training in environmental fields; and (d) establish appropriate arrangements for the review of environment-related research and teaching

programs.

2. Introduction of the project

2.1 The Ministry of Education decided to support environment-related programs at college-level institutions for solving the environmental pollution problems, prepared a loan project and requested to the Ministry of Finance and Economy at that time to introduce a loan from IBRD for such purpose. The Ministry of Finance and Economy, after getting the agreement of the national assembly on the proposed loan, asked for the loan to IBRD. IBRD sent an identification mission consisted of experts professional in the related fields to check the contents of the proposed loan, and another for its appraisal.

Appropriateness of the loan proposal was recognized and the loan agreement was signed on June 30, 1993 for the loan of US$ 60,000,000 or less after negotiations on the agreement conditions in Washington, D. C. The Korean Government sent to the Bank papers required for the loan such as legal comments on the agreement, etc., and the Bank notified the Korean Government the effectiveness of the Loan Agreement on September 3, 1993.

2.2 With this notice, the plan of the loan project was actually put into implementation, beginning with establishing the Ministry of Education Special Account from the loan proceeds of US$60,000,000 or less. The project contents were as follows in general:

(a) Provision of equipment and training to enhance NICEM's capacity to undertake environment-related researches - US$ 12,300,000.
(b) Provision of equipment for improving in the quality of environment -related research and teaching in national agricultural and veterinary colleges - US$ 47,700,000.

(c) Organization of Environmental Education Review Committee (EERC) and Environmental Research Advisory Committee (ERAC) for recommendation on environmental education and researches.

3. Implementation of the Project

A. Selection of Participating Institutions and Establishment of NICEM

3.1 Selection of Participating Institutions

For realizing the prospect described in Chapter 1. Foreword, the 14 national agricultural and veterinary colleges of the project were selected as project institutions from the designing stage of the project aiming at an early achievement of project purposes and considering the estimated fund limit. The special meaning of the project in addition to supporting the related 14 institutions in education and research activities is to have

established NICEM to help other national, public, and private institutions other than the project ones at the same time by rendering the sophisticated high cost environment-related equipment in NICEM for their researches and joint use. This part of the project seems to have a high value-added achievement.

3.2 Establishment of NICEM

The National Instrumentation Center for Environmental Management (NICEM) was established on the Suwon campus of Seoul National University (SNU) by the project to achieve value added in the form of creating an efficient mechanism for centralizing common research activities, which would be of particular benefit to smaller institutions. Based on the Presidential Decree dated March 1, 1996, NICEM has been legally established in the SNU Organization Act as a research support institution affiliated to College of Agriculture and Life Sciences (CALS), SNU. NICEM is now recognized as a nationwide research support institution whose operation budget is mainly appropriated by MOE. CALS, SNU also takes responsibility for the NICEM operation. During the last five years, the space for NICEM has expanded to 1,845m^2 in four different buildings to house research equipment procured by the project. Currently, 26 staff members and 10 graduate student helpers are actively involved in the NICEM operation. Of 25 staff members, there are five joint-appointed professors, four administration staff, 7 post-doctoral research associates, five research assistants, four lab technicians, etc. The graduate student helpers are working for NICEM on a part-time basis, and help maintain laboratories of NICEM.

B. Equipment Procurement

3.3 General procedures of equipment procurement.

The bulk of the work in equipment procurement was undertaken by the Supply Administration, Republic of Korea (SAROK), which is highly experienced in procuring equipment under the Bank's international competitive bidding (ICB) procedures. In 1994, the first year of the project implementation, equipment lists and specifications provided by the project institutions were submitted to SAROK after evaluation for their appropriateness by the Equipment Specification Review Committee (ESRC) of MOE. However, the evaluation procedure by ESRC of MOE was abolished from 1996 in order to expedite the procedure of equipment procurement. On the basis of equipment lists and specifications submitted by project institutions, SAROK prepared bidding documents, invited bids, evaluated them in conjunction with the institutions, and made contract awards with their agreement. In most cases the supplier was responsible for installation, initial testing and operation of the equipment as specified in the contract. It has usually taken three to eight months between the procurement request to SAROK and the equipment installation. Most of equipment were under one or two year warranty.

3.4 Equipment procurement by NICEM

NICEM has made every effort to accommodate general opinions on selection of equipment that needed to be procured by NICEM as a common research facility. At the same time, NICEM has tried to procure equipment which was so expensive that

any individuals or small institutions could not afford. The equipment lists and specifications were prepared by the Laboratory Operation Committees (LOC) of NICEM, which consisted of faculty members from various universities. The operation committees called for requests of equipment that needed to be procured by NICEM. The requests from faculty of both public and private agricultural and veterinary colleges were evaluated by LOC, and the final equipment lists and specifications to be procured in each year were determined. The equipment lists and specifications were reviewed by the Equipment Specification Review Committee (ESRC) of CALS, SNU, and modified if necessary, before submitting to SAROK. Contract prices for most of equipment procured by NICEM were approximately more than US$25,000. The most expensive equipment was Nuclear Magnetic Resonance Spectrometers (600MHz liquid and 400MHz solid), whose contract price was approximately US$1,300,000. As of 30 December, 1998, the equipment procurement was completed. A total of 249 sets of equipment of approximately US$11,830,000 equivalent have been procured. During the last five years, NICEM has expended ₩940,000,000 (circa US$783,000 in case the conversion rate of US$ 1 is 1,2000 Won) for repairing and furnishing the laboratories to house research equipment.

3.5 Equipment procurement by agricultural and veterinary colleges.
The Loan Project was an excellent opportunity for the participating agricultural and veterinary colleges to procure research equipment for not only laboratories of individual faculty members but also their campus-wide common research facilities. During the last few years, they have made a great deal of efforts to establish their own campus-wide common research facilities and MOE has encouraged and supported financially to build independent buildings to centralize expensive research equipment in the campus. Among the participating colleges, most of them have brand-new buildings to house equipment, of which a substantial portion was procured through the project. Selections of equipment to be procured for the common research facilities were made by special committees which consisted of faculty members of the schools representing individual departments or various fields of sciences. Laboratories of individual faculty members have been greatly improved by the project. Depending upon schools, approximately US$10,000-50,000 was allocated to individual faculty members for their own laboratories.

C. Library Material Procurement

3.6 Library materials were procured on the basis of direct purchase after negotiating for discounts with distributors authorized by respective publishers. NICEM has completed the library material procurement in 1997 by purchasing CD-ROM's and micro-fiches of literatures and databases for environmental sciences. The CD-ROM's were installed in the computer system of the Agriculture and Life Science Research Information Center located at the Agricultural Library of CALS, SNU. The micro-fiches were also installed at the library. All of them are easily available to anyone.

D. Overseas Training and Visiting Expert Program

3.7 Since 1994, a total of 150 overseas trainees and 45 foreign experts have participated in the overseas training and visiting expert program. The overseas trainees included 112 professors and 19 equipment operators from 23 agricultural and veterinary colleges, and 19 staff members of MOE and SNU. The overseas trainees have presented lectures in the yearly symposia which were held by NICEM to propagate their achievement and experiences during the training periods. The foreign experts were from 11 countries. They have given seminars and workshops at various agricultural and veterinary colleges. The overseas training and visiting expert program provided excellent opportunities for Korean scientists to establish international collaborations for their research. Some of the foreign experts have made good contributions for operation of NICEM.

E. EERC and ERAC Activities

3.8 Since 1993 when EERC and ERAC were established in MOE, both committees had their meetings in principle once or twice a year. Members of both committees represented agricultural and veterinary colleges, and relevant authorities in the Korean Government such as Ministries of Education, Environment, Science and Technology, Health and Welfare and Rural Development Administration. At the annual meetings, both committees have reviewed activities of NICEM and made suggestions on the NICEM operation. The major achievement of ERAC and EERC was conducting researches on 'Strategies for improving the status of agricultural environment with special emphasis on livestock waste management' and 'Development of environmental education programs in agricultural colleges for the 21st century', respectively. The research fund was provided through NICEM by MOE in 1995-1996. EERC has published results of their research in a book entitled 'Environmental Education Programs in the Agricultural College for the 21st Century and the Improvement of Agricultural Environment in Korea'. The authors have reviewed related literatures and college curricula extensively, and made suggestions on ideal curricula for environmental education at the college-level.

4. Evaluation of the Project Implementation

4.1 Equipment procurement.

By procuring equipment of US$58,600,000 equivalent, the project institutions were able to enhance greatly their capacity to undertake basic and applied research into key environmental problems. Especially, NICEM has become pivotal in facilitating and supporting the collaborated agricultural and veterinary medical research that is indispensable for tackling complicated environmental issues on the national and international scale. Since the inception of the equipment service by NICEM in 1996, the number of users has increased rapidly. Approximately 700 researchers from 51 public or private institutions have used the NICEM equipment. There have been no serious problems in the process of equipment procurement except for the first year of the

project. In 1994, very little loan was disbursed for the equipment procurement because of disagreement in the loan allocations between the project institutions. Also, NICEM was not legally stabilized and did not have operation budget and personnel enough to carry out the project implementation in 1994. However, most of problems were solved before the end of 1994, and the equipment procurement by all project institutions went well from 1995.

4.2 Overseas training and visiting expert program.

This program has provided excellent opportunity for agricultural and veterinary colleges to fortify their teaching and research in environmental sciences. This program was originally scheduled to be completed by the end of 1996. However, only 42% of US$1,500,000 was disbursed by the program until 1996. The program was extended until 1998 with some changes to open the program for not only professors but also lab technicians and graduate students who were in charge of operation and maintenance of expensive research equipment procured through the loan project. This program has made infrastructural contributions for the success of the loan project by enhancing trainees' ability to operate sophisticated research equipment, and to establish international collaborations for research and teaching in environmental aspects of agricultural and veterinary sciences.

4.3 ERAC and EERC activities

Although ERAC and EERC have been maintained during the project period, activities of both committees have not been as effective as was expected originally when the project was developed. The most significant achievement was the publication of a book by EERC, entitled 'Environmental Education Programs in the Agricultural College for the 21st Century and the Improvement of Agricultural Environment in Korea'. The book is a good guideline for developing teaching programs for environmental sciences in agricultural colleges in Korea. For example, the book was very useful when CALS, SNU developed a long-term program for its research and education in environmental and ecological sciences. ERAC and EERC have also made contributions for emphasizing environmental aspects in the NICEM operation by reviewing its activities and making suggestions.

5. Conclusion

5.1 The loan project was very successful and timely implemented for Korean agricultural and veterinary colleges, which needed to strongly address environmental aspects in agricultural and veterinary sciences, and to drastically improve their research equipment for solving environmental problems.

5.2 NICEM would be quite sustainable in the future. On the basis of a strong commitment by MOE, NICEM has established various programs to generate funds for its institutional sustainability. Considering the leading position and the equipment procurement of NICEM, NICEM has become pivotal in facilitating and supporting the collaborative agricultural and veterinary research that is indispensable for tackling

complicated environmental issues in Korea.

5.3 Requests by Project Institutions

During implementation of this project, project institutions made following requests. These will be considered and reflected as much as possible in the annual process of budgetary appropriation for proper operation and maintenance of the equipment provided from the loan, and for necessary replacement of them when required under technical development. Operational technicians might be increased in future, and other costs incidental to operation and maintenance of the equipment might also be increased at certain rate of the related equipment cost. The request to the World Bank from NICEM is cordially transferred to the Bank by the following paragraph of 5.3.2.

5.3.1 Request to MOE by NICEM

NICEM has procured many research equipment which are state of art. From now on, success of NICEM depends on active use and proper maintenance of equipment. MOE was requested to provide sufficient budget for operation and maintenance of equipment, and for staffing and upgrading obsolete equipment.

5.3.2 Request to IBRD by NICEM

The role of IBRD is very important to promote NICEM as an international institute for environmental research and education. In cooperation with SNU, NICEM has strong capacity to operate education programs in environmental sciences and technology for trainees from developing countries. With the successful experience, NICEM has great potential to be a regional center in East and Southeast Asia and Pacific Regions for environmental education and research projects that the Bank would develop in the future. In this respect, guidance by IBRD is much required.

5.3.3 NICEM and project institutions of agricultural and veterinary colleges are requesting to make the period of procurement shorter for them to adequately cope with the rapid change in their research and educational equipment. Project institutions also request placing professional technicians and appropriation of enough budget for operation and maintenance, and for other costs incidental to operation of the equipment as the research equipment is becoming more and more complicated, their sizes larger, and their operational technique more sophisticated along with the very rapid development in the recently advanced sciences and technology.

Appendices: related statistics

Table 1: Overseas Training
Table 2: Visiting experts
Table 3: Project Cost Summary by Category
Table 4: Project Cost Summary by Year
Table 5: Use of Equipment
Table 6: Annual Research Papers Published

Table 1: Number of Fellowships and Staff-months

Classification	Original plan		Actual	
	No. of fellowships & staff	Total months	No. of fellowships & staff	Total months
Overseas training	70	420	112	383
Survey training	0	0	19	9
Technical training	0	0	19	17.5
Total	70 pers	420 months	150	989

Table 2: Visiting Experts

Classif	Original plan		Actual	
	Total experts	Total days	Total experts	Total days
visiting experts	12	1,080	45	989

Table 3: Summary of Project Costs by Expenditure

Component	Appraisal estimate(US$M)			Actual costs(US$M)		
	Local costs	Foreign costs	Total	Local costs	Foreign costs	Total
Equipment	0	58.4	58.4	3.7	58.6	62.3
Equipment transportation and installation	3.1	0.4	3.5	2.5	0.0	2.5
Operations and maintenance	8.2	0.9	9.1	2.7	0.0	2.7
Consumable materials	8.2	0.9	9.1	1.4	0.0	1.4
Overseas training	0.1	0.9	1.0	0.0	1.0	1.0
Visiting experts	0.1	0.6	0.7	0.0	0.3	0.3
Library materials	0	0.1	0.1	0.0	0.3	0.1
Total	19.7	62.2	81.9	10.3	60.0	70.3

Table 4: Annual Project Costs

(Unit: US$ million)

Year	Original plan			Actual expenditure		
	Expenditure	Accumulated	Ratio(%)	Expenditure	Accumulated	Ratio(%)
'94	4.0*	4.0	7	4.0*	4.0	7
'95	12.0	16.0	27	1.3	5.3	9
'96	22.0	38.0	63	14.6	19.9	33
'97	15.0	53.0	88	22.6	42.5	71
'98	6.0	59.0	98	14.9	57.4	96
'99	1.0	60.0	100	2.6	60.0	100

* indicates the initial deposit in the MOE Special Account

Table 5: Summary of Use Hours of Equipment

(Unit: hour)

Field	Annual use hours of equipment							Total units	Average *
	'93	'94	'95	'96	'97	'98	Total		
Coll of Agri	328	6,868	165,704	496,083	783,497	894,032	2,346,512	3,949	594
Coll of Vet	1,500	1,610	89,048	105,685	181,450	107,924	487,217	1,422	343
NICEM	0	23,203	52,300	83,872	106587	135,893	401,855	249	1,614
Total	1,828	31,681	307,052	685,640	1,071,534	1,137,849	3,235,584	5,620	576

"Average" means (total annual equip't use hours) / total units of equip,t

Table 6: Number of Publication, or Patent Right

Year	Original plan	Actual	Research 1	Research 2	Research 3	Patent right
'93	303	493	473	135	53	1
'94	604	785	777	232	69	4
'95	597	1,095	1,094	256	104	9
'96	835	1,651	1,622	338	284	46
'97	1,145	2,218	2,118	481	356	43
'98	1,051	1,872	1,755	408	359	35
Total	4,535	8,114	7,839	1,850	1,225	138

Note: 1. "Research 1" indicates number of domestic and int'l publications
2. "Research 2" indicates number of the environment-related papers
3. "Research 3" indicates number of those used in industries

(The end)